originals verified by other authenticated persons.

2. It is normally observed that the application forms are of as many types as the number of agencies seeking applications. Let us evolve a consensus on the contents of a bio-data/application format. Once the bio-data structure becomes uniform, the chances of misrepresentation of facts will be minimum. There will be minimum trouble to the applicants too and verifying authorities as well.

The issue of acknowledgement/regret letters was raised by Divakara Sastry (*Curr. Sci.*, 2002, **82**, 611). In this context, I would like to suggest that a standard acknowledgement card be made mandatory to be enclosed with each application. Accordingly, once the appointment procedure is finalized, a regret letter can be issued to the not-so-lucky candidates.

MANISHA PANDEY

C/o V. Pandey,
Parbati HE Project,
NHPC, Bhuntar,
Kullu 175 125, India

NEWS

Mathematics prizes

The four-yearly Fields Medals (the mathematician's equivalent of the Nobel Prize) and the Nevanlinna Prize were awarded on 20 August 2002, at the opening ceremony of the International Congress of Mathematicians, held in Beijing. The Fields Medals went to Laurent Lafforgue of Institut des Hautes Etudes Sceientifiques in Bures-sur-Yvette, France and to Vladimir Voevodsky of the Institute for Advanced Study, Princeton, NJ, USA. The Nevanlinna Prize was awarded to Madhu Sudan of the Massachusetts Institute of Technology, USA.

The work of Lafforgue is on the so-called Langlands programme, which concerns certain deep connections between number theory, analysis and group representation theory, while that of Voevodsky is on 'motivic cohomology' (algebraic geometry). Madhu Sudan has worked on non-approximability of optimization problems and coding theory.

Madhu Sudan graduated with a B Tech degree from IIT Delhi in 1987. Both Lafforgue and Madhu Sudan are Adjunct Professors of the Tata Institute of Fundamental Research, Mumbai.

Human brain bank at NIMHANS

A Repository for Human Brain Tissue is available in the form of a brain bank at the Department of Neuropathology, National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore. This is a national facility jointly funded by the Department of Science and Technology, Department of Biotechnology, Indian Council of Medical Research and NIMHANS.

This brain bank collects, preserves and provides fresh human tissue for researchers, especially those in the field of neurosciences, with particular relevance to degenerative diseases, psychiatric diseases, neurobiology and neuroinfection. Research in these areas requires use of both animal models and human brain tissue for understanding several brain functions and disorders.

The genesis of this repository was in 1984, after a meeting in Bangalore considered the overall direction of neuroscience activity in the country. One consequence of this meeting was the finding that although neuroscience research was spread all over the country, there was little interaction among various branches pertaining to neuroscience research. The Repository for Human Brain Tissue was then set up at NIMHANS in 1995.

The protocol followed at the brain bank in NIMHANS is to collect brain tissue following informed consent of close relatives. Brain tissue is collected after death, from people who had either suffered neurological diseases or after-accident trauma but are free from neuro-psychiatric disorders, with the latter serving as normal controls in research. The post-mortem time for collection ranges between 4 and 24 h after death. According to Shankar and Mahadevan of the Neuropathology Department at NIMHANS, 'one half of the fresh brain from neurodegenerative and psychiatric disorders is frozen at – 70°C, while the other half and brains from infective conditions are formalin-fixed, which can be used for pathomorphological studies'[1]. Brain and tissue fluids such as serum and cerebrospinal fluids are also collected and preserved. Shankar is the project coordinator of the brain bank which is run as a non-profit facility.

An example of scientific work carried out utilizing the material collected at the brain bank is that from the laboratory of Vijayalakshmi Ravindranath, National Brain Research Centre, Gurgaon[2], which has been conducting research for over a decade now on the topic of drug metabolism in the human brain. This is an area of research which has evinced keen interest for the role that the brain plays in drug-detoxifying capability and its relation to certain neurodegenerative diseases such as Parkinson's disease.

S. Sriramachari, Institute of Pathology, Safdarjung Hospital, New Delhi, when asked to comment on the utilization of the brain bank, felt that researchers should exploit the facilities available; however, care should be exercised regarding research topics. He suggested that research areas in both clinical diseases and metabolic diseases must be pursued using this facility, as well as the search for the anatomical basis of schizophrenia. He wished to see greater synergy between research teams comprising various disciplines of neurosciences in the pursuit of a larger goal. At present, teamwork to achieve a targeted goal is missing. He called for a more region-specific understanding of certain diseases using adequate sample sizes and age-distribution correlations. He felt that more work needs to be done in the area of atherosclerosis and mucoid vasculopathy. Other areas that need targeted projects are those of blood tissue research, tissue histochemistry and tissue immunology.

P. N. Tandon, National Brain Research Centre Society, New Delhi whose brainchild this facility is, remained quite optimistic about the future of the brain bank in India and hoped that such facilities would be opened in other parts of the country also.

For a facility of this nature used for storing human brain tissue, a few key pointers to the validity of such a facility or its expansion in the future cannot be overlooked. For reasons that are obvious, human ethical issues would always crop up in the running and usage of a facility that takes tissues from cadavers. From a social perspective, it has to be ensured that such a facility does justice to the very reason for its formation in the first place – better understanding of the diseases that afflict the human brain. The usage frequency of the facility and the type of projects have to be monitored from time to time. It must be ascertained whether projects that require usage of the brain tissue yield tangible benefits to neuroscience research and to humankind.

Could any of the projects carried out with the use of material from the brain bank just as well have been performed using animal models? Are the results from such projects commensurate with the dignity of the individual who gifted his/her brain for the advancement of science? Is there sufficient usage of already stored brains? Here it must be mentioned that there are not enough users at this point in time. Could non-usage and passage of time need stored tissues to be discarded at some stage? Are the projects of significance to the general community of medical and molecular biological researchers? Is there a concerted effort to solve identified problems peculiar to our country? If any of the answers do not live up to the original mandate for which such a facility is made, then a rethink may be necessary.

1. Shankar, S. K. and Mahadevan, A., *Ann. Indian Acad. Neurol*., 1999, **2**, 59–70.
2. Chinta Shankar, J., Pai Harish, V., Upadhya Sudarshan, C., Boyd Michael, R. and Ravindranath Vijayalakshmi, *Mol. Brain Res*., 2002, **103**, 49–61.

Nirupa Sen, 1333 Poorvanchal Complex, JNU New Campus, New Delhi 110 067, India (e-mail: nirupasen@vsnl.net).

MEETING REPORT

World conference of bryology*

Bryophytes (liverworts, hornworts and mosses) are the simplest, green land plants that ventured first on barren land. Gametophyte is a thalloid or has leafy axis, and arises from the protonema. Sporophyte is a partially-dependent capsule. Nearly 200 bryologists attended the 'World Conference of Bryology' at the National Botanical Research Institute (NBRI), Lucknow. In the inaugural session, H. Y. Mohan Ram elaborated that bryophytes made possible the colonization of land by animals and evolved as unparallel in diversity of size, structure, chemistry and function. He specified features of bryophytes that serve as study organisms in macroevolution, population genetics and ecology. He emphasized on the study of mineral relationship, response to pollutants and the stress-tolerant factor. According to P. Pushpangadan (Lucknow), bryophytes contain most species-rich lineages of land plants and present a challenge for understanding the evolutionary diversification. S. R. Gradstein (Germany) explained that bryophytes are complicated in ontogeny but are simple in their morphology and genetics, and serve as model system and a key to understanding the relationship among embryophytes.

T. Hallingback (Sweden) suggested a study of taxonomy, distribution and inventorization of threatened bryophytes to analyse the impact of disturbance for conservation. V. Virtanen (Finland) described a case of homicide in which fingerprinting of bryophytes of the site was used to produce evidence against the suspect. Gradstein pronounced Plagiochilaceae as the indicator taxon and discussed its role in the hydrology in tropical forests and elaborated the biosystematic analysis. D. S. Rycroft (Scotland) discussed the chemosystematics of *Plagiochila*. D. G. Long (UK) discussed molecular phylogeny of *Asterella* and suggested that the genus is paraphyletic and other members of the family are derived from within *Asterella*. S. C. Srivastava (Lucknow) spoke on the Indian hepatics (850 species) and marked 20% species as endemic, rare and highly vulnerable. V. Nath (Lucknow) presented distribution, morphological plasticity and molecular aspects of *Frullania*. He listed bryophytes in folk medicines. He reported *Lejeunea cocoes* and *Anacolia menziesii* which are new to India. D. Kumar (Lucknow) presented taxonomy and dis-

*A report on the 'World Conference of Bryology' held in the National Botanical Research Institute, Lucknow during 23–30 January 2002.

tribution of rare hepatics *Haplomitrium* and *Calobryum*. He described a new species, *Herbertus mehrae*.

According to R. E. Longton (UK), annual shuttle mosses appear in autumn and wither in spring after producing spores. He showed that the spores situated adjacent to the inner capsule wall are non-viable. He revised Entodontaceae taking into account the ornamentation patterns of peristome. H. S. Korpelainen (Finland) discussed the crucial role of gemmae in the dispersal and maintenance of populations in different climates. M. Pohjamo (Finland) concluded that the genetic variations in different populations of *Trichocolea* originate from somatic mutation or from recombination due to occasional sexuality.

L. Soderstrom (Norway) showed the more opportunistic behaviour of *Pogonatum* in temporal, lowland disturbed habitat than those in the stable alpine habitat. T. Cao (China) discussed cytotaxonomy of Lophoziaceae and relevance of ultrastructure of spore in systematics. He showed 12 geographical elements of *Ptycomitrium* in the world and interpreted its origin in Pangana, Laurasia and Gondwanaland. P. L. Uniyal (Delhi) exhibited the cytological data for the circumscription of taxa of various ranks and elucidation of phylectic trends in mosses. He said that the variation in chromosome numbers is associated with morphological complexities and habitat distribution, and high grade of polyploidy confers some selective advantage for the plants to colonize in adverse conditions.

P. Joshi (Nainital) discussed uptake of nutrients in epiphytic bryophytes and their role in the conservation of nutrients. A. K. Srivastava (Lucknow) deliberated on the taxonomic relationship among fossil bryophytes. B. L. Chaudhary (Udaipur) proved the allelopathic potential of *Lantana* against regeneration of bryophytes and mentioned the indicator value of bryophytes against allelochemicals. D. K. Saxena (Bareilly) found a trend of increasing level of lead in urban mosses and marked *Hylocomium* as highly tolerant to metallic polluters that show hyper-accumulation potential with minimum change in physiochemical parameters. Anima Langer (Jammu) reported that variability enables taxa to adapt and evolve in changing environment, and elaborated the intraspecific variability in *Reboulia hemispherica*. Geeta Asthana (Lucknow) discussed distinct characters for taxonomy of Lejeuneaceae. Sarla (Delhi) showed the inhibitory effect of IAA and NAA on the growth of protonema of *Bryum* and production of gemmae on the protonema in response to kinetin. A. K. Asthana (Lucknow) exhibited distinct characters for recognition of the taxa of Anthcerotaceae. D. K. Singh (Dehradun) focused on the threatened liverworts and formulated an action plan for conservation through awareness, capacity building, surveys, and monitoring. B. S. Dixit (Lucknow) spoke about the medicinal value of biologically active substances of liverworts.

B. C. Tan (Singapore) showed various floristic provinces of the Indian subcontinent based on the distribution and richness of species. He focused on the molecular systematics using cpDNA sequences and morphological data. M. Higuchi (Japan) specified the mosses of Pakistan as Holarctic with prevalence of Eurasian and Himalayan elements. He estimated 334 species with Pottiaceae as the dominant family. B. O'Shea (UK) mentioned the species richness and endemism in Sri Lankan mosses. S. N. Joshi (Nepal) listed 115 species from the tropical region of Nepal. J. N. Vohra (Karnal), J. Lal (Allahabad), B. D. Vashishtha (Kurukshetra) and S. D. Tewari (Pithoragarh) highlighted the mosses of Eastern and Western Himalaya and northern plains of India, and emphasized the need for conservation of habitats. They featured phytogeographical aspects and mentioned 30% species as endemic and 60% as rare and endangered. D. Sharma (Lucknow), M. N. Vijayan (Margao), S. D. Phatak (Madgaon), A. E. D. Daniels (Nagercoil), G. T. Dabhade (Kalyan), T. P. Sharma (Udaipur), G. V. Kumar (Tiruchirapalli) and M. C. Nair (Calicut) spoke about the mosses of central India, Eastern and Western Ghats and Gujarat. Beata Papp (Hungary) presented the threatened status of bryophytes. H. Deguchi (Japan) described monoplastidic sporocytes that established through several successive mitosis of sporogenous tissue and produce high ratio of elaters and spores. R. T. Corlett (China) listed 353 species and identified 16 hot spots in Hong Kong. He studied the effect of environmental variables on brycommunities and viewed that non-tropical species are more likely to be rare/threatened than tropical ones, and these taxa are denser in higher altitudes. H. Mohamed (Malaysia) spoke about diversity and biomass, and its importance in hydrology in the forest ecosystem. He correlated polymorphism in mosses with light intensity factor.

X. L. He (Finland) clarified the generic boundaries and phylogenetic relationship within Geocalycaceae. S. Huttunen (Finland) proved monophyletic origin of Brachytheciaceae and Lembophyllaceae on the basis of cpDNA and nrDNA sequence data. She suggested the rearrangement of traditionally included taxa of Meteoriaceae and Trachypodaceae. She revealed that the pendent life-form has evolved independently and is regarded to be a derived character. H. Tsubota (Japan) presented phylogenetic inference and recognized the Hypnaceae as polyphyletic and Sematophyllaceae as monophyletic groups based on the rbCl sequences. H. S. Negi (Palampur) mentioned that geographically restricted and taxonomically unique species are valuable for conservation. He ranked coniferous forests as highest in conservation priority as they contained habitat-specific and geographically restricted taxa. M. R. Suseela (Lucknow) dealt with nitrogen fixation and maintenance of soil fertility by bryophyte–algae associations. N. Bhowmik (Allahabad) reported the damage of gametophores by endophytic fungi *Gloeosporium*. S. N. Srivastava (Allahabad) recorded that oak trees provide luxuriant growth of bryophytes and marked *Lacnora* (crustos lichen) as pioneer vegetation followed by leafy liverworts and then mosses.

P. Chaturvedi (Dehradun) demonstrated the inhibitory effect of IAA on protonemal growth, and promotion of protonemal growth and buds by 2,4-D and cytokinins. N. Pandey (Nainital) testified the inhibitory effect of bryophyte extract on some pathogens. Asha Gupta (Lucknow) reported highly resistant sporopollenin in the bryophyte spores preserved in fossils. M. Tanwir (Jammu) mentioned that the diverse climate and habitat favour speciation and endemism. A. Kumar (Rai-Bareilly) observed a trend of decreasing chlorophyll content in bryophytes from polluted areas. D. K. Upreti showed that mosses are major substrates for lichens in alpine regions. G. S. Deora (Udaipur) revealed the formation of secondary gemmae on protonema that easily colonize in adverse conditions.

Pushpangadan spoke on the protection and promotion of the rights of the community, farmers and indigenous people on biodiversity and advocated the equivalent share of benefits to them, arising from the commercial use. S. Sopory (New Delhi) elucidated that the plants sense abiotic stresses via various signal transduction pathways. In salinity the calcium sensor activates the kinase (Ca-binding protein) and sodium is thrown out of the cell.

The deliberations and discussion resolved (i) to collate the pertinent information on the endangered taxa for public attention and scientific record, (ii) to encourage floristic and taxonomic study, especially in the hot spots and identification of sensitive and tolerant species through molecular markers, (iii) capacity building, and (iv) utilization of biomass, exploitation of indicator species, pollution monitoring, analysis of the potential chemicals and study of bryophyte-associated animals and microorganisms.

During a field excursion to Nainital, the delegates caught glimpses of bryo-vegetation of various habitats, mineral-enriched substrates, indicator value and role of mosses in building of mineral rocks. They marked various growth forms in relation to the habitat and micro-climatic condition. The conference was immensely successful and well organized.

P. L. Uniyal, Department of Botany, University of Delhi, Delhi 110 007, India. (e-mail: rads26@hotmail.com).

MEETING REPORT

Learning to change*

The crucial and varied needs for, as well as some possible processes of change in agricultural R&D, were analysed by experts and policy makers in a workshop on 'Agricultural Policy: Redesigning R&D to Achieve the Objectives'. The workshop brought together several actors and agencies concerned about the future of agricultural knowledge systems in India.

A crucial expectation from the workshop was to gain insights into the relationship between agricultural science and policy in the Indian context. While the recent National Agricultural Policy document of Government of India provided an immediate focus, the larger question was concerned with the capacity of R&D to identify and respond to the critical and durable elements of agricultural policy.

The opening session on 'The context for change', proclaimed that change in R&D was imminent. The session began with a clear statement of the workshop objective, viz. 'To deliberate and arrive at some crucial suggestions and an agenda for action to guide this change'.

As the main sponsor and organizer, the National Academy of Agricultural Sciences (NAAS) made an explicit demand for shifting from perceptional guidance in R&D to well-debated and analysed measures for change. The Academy (President V. L. Chopra) desired that these debates and suggestions be: (a) scientific and analytical, (b) honest and uninhibited. Presenting the ICAR perspective, the DG, ICAR, demanded that the workshop should provide a picture of how to go about changing R&D organizations. The keynote address by A. Vaidyanathan (MIDS, Chennai) made a candid assessment of the changing context of agriculture, and urged that innovation in the public sector agricultural R&D be conversant with these dynamics. The past decade has witnessed significant changes in growth rates and trends in agricultural production/productivity, resource use – in irrigated and rainfed agriculture, and has given us evidences of ecological degradation. Agricultural R&D continues to appease itself with claims of success (limited often to varietal release), while there is evidence of declining productivity of disciplinary commodity-based knowledge in the face of these agro-ecological problems. Other changes in context include increasing presence of private sector and profit motives in agricultural R&D, an erosion of public sector commitment to basic and poverty-oriented knowledge, and the potential of emerging biotechnology and information technology regimes. The demands of 'sustainability' and poverty reduction, the need for introspection and the role of evaluation in R&D, and the dialectical relationship between data generation and utilization in R&D (as one of the most important inputs for reflection and changes in the direction of research), were also presented as critical changes in context. The four papers presented in this session, the discussant's response and inputs from the floor, highlighted the important milestones of success in green revolution technology achieved thus far. This success, however, must not perpetuate a 'business as usual' approach to the generation and utilization of knowledge and technologies in the agriculture sector. The innovation system must now look for ways forward to the next stages of excellence in science and success, agro-ecological and socio-economic goals.

The session on 'Organization and management of research for sustainable agriculture' highlighted the need for an analytical framework that can guide the transition of research organizations from their productivity goals to sustainability goals. The papers and interventions questioned the capability of the existing research system to engage effectively with the institutional landscapes and dialectical processes of agricultural innovation. In the session on 'Technology development, diffusion and linkages', these organizational issues were analysed further. It was argued that the linear model of technology generation, diffusion and adoption in spatially and functionally dif-

*A report on the workshop on 'Agricultural Policy: Redesigning R&D to Achieve the Objectives' held at the Indian National Science Academy premises, New Delhi between 10 and 11 April 2002, sponsored by the National Academy of Agricultural Sciences, and organized jointly by the Centre for Advancement of Sustainable Agriculture, National Institute of Science, Technology and Development Studies and National Centre for Agricultural Economics and Policy Research.

ferentiated organizations, must give way to a nonlinear model of continuous participatory learning within the larger agricultural innovation system. The latter, the innovation systems approach, based on iterative learning and building partnerships with the relevant actors/ agencies in the agricultural innovation system, demands institutional and organizational changes. There is a felt need to strengthen social science research in agricultural innovation systems, to enhance the social and ecological learning capacity of R&D organizations. Finally, the papers in the session on 'Addressing sustainability goals' were concerned with two crucial aspects of long-term sustainability in agricultural innovation systems: (a) the agricultural education system to produce dynamic manpower, and (b) the natural resources research sub-system to ensure sustainable use of and conservation of natural resources. Both the groups of papers addressed institutional and organizational issues that impede the goals of sustainability in Indian agricultural R&D.

Some of the important issues and suggestions that emerged from the technical sessions were discussed further in the last session. The main recommendations of the workshop are:

- The policy regimes of the past, which put a huge public R&D system in place, have changed. The current economy and policy will not support this R&D system whose performance has definitely declined.
- Since the productivity of crop and disciplinary subject-matter research has reached a plateau, an interdisciplinary issue-based research approach is necessary.
- Success of the green revolution should not lead to complacency in this era with pressures from WTO, emerging technologies like biotechnology, and declining international (CG system) support for agricultural R&D. New methods of funding R&D and partnerships in R&D must be sought.
- Personnel policies in the system need to undergo a change to promote innovation, with due reward to merit.
- Major changes in the conduct of R&D are needed, most crucial being an analytical framework to orient agricultural research to meet sustainability goals and specific poverty-reduction goals.
- Indian agricultural R&D must seek the processes and structures for an internal thinking mechanisms at all levels.
- While decentralization and accountability down the line to the Principal Investigators have been recommended time and again, it has always been translated to mean financial decentralization. A progressive and dynamic R&D system that caters to policy demand for agro-ecological, diversified strategies for agriculture demands decentralization of ideas and approaches in the conduct of research.
- Increasing stakeholder involvement in research decision-making and better research partnerships in technology generation and utilization demand institutional learning and organizational changes that enable these learning processes.
- Better social science research capabilities to analyse and develop R&D strategies for specific agro-ecological regions or farming systems perspectives. This will, therefore, call for greater interaction between natural sciences and social sciences.
- There is a need for emphasis within ICAR and SAUs (in the public sector) on an innovation systems approach to agricultural policy, science, and development.

It was concluded that professionals in the innovation system, policy-makers and other stakeholders have to define the socio-economic and sustainability goals in an ecoregional perspective and work towards reorienting location-specific R&D needs to meet these goals.

This workshop was a small beginning; yet, a significant one in which the need for change in R&D was discussed and analysed, openly and honestly.

R. S. Raina, National Institute of Science, Technology and Development Studies, Dr K.S. Krishnan Marg, Pusa, New Delhi 110 012, India and **I. P. Abrol**†, Centre for Advancement of Sustainable Agriculture, C-9/ 9564, Vasant Kunj, New Delhi 110 070, India. †For correspondence. (e-mail: iabrol@vsnl.com).

NEWS FOCUS

Science in Thiruvananthapuram

Kerala. Viewed from the skies is lush green, white surf lapping the coastline and aptly described as 'God's own country'. 'Keralam' is 'land of coconut trees'. But, can this remain so? Kerala is beset with problems; those requiring intervention of scientists. A 570 km coastline, several rivers and estuaries need scientific monitoring. A high population density means more erosion and more landslides. Improved land use, alternate building materials, pollution checks, water budgeting, watershed development, terrain analysis, soil studies, materials development and biodiversity protection need attention. Geoscientific studies of minerals, seismology and understanding natural radioactivity occurring on the Kerala coast are necessary for Kerala's continued health. Thiruvananthapuram, Kerala's capital city has several institutions involved in scientific and medical research. Kerala is the first state in the country to have a State Committee on Science and Technology, which now includes Environment also, and is known as STEC (Box 1).

Centre for Earth Science Studies

The Centre for Earth Science Studies (CESS) celebrates its silver jubilee in 2002–2003. For the development of

Box 1.

Research institutions under STEC

Kerala Forest Research Institute, Thrissur
National Transportation Planning and Research Centre, Thiruvananthapuram
Centre for Water Resource Development and Management, Kozhikode
Centre for Earth Science Studies, Thiruvananthapuram
Tropical Botanic Garden and Research Institute, Thiruvananthapuram
Agency for Non-conventional Energy and Rural Technology, Thiruvananthapuram
Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram

Institutions receiving partial support from STEC

Malabar Botanical Garden and Society, Kozhikode
Sophisticated Test and Instrumentation Centre, Kochi
Integrated Rural Technology Centre, Palakkad
Kerala Statistical Institute, Thiruvananthapuram
Centre for Mathematical Sciences, Thiruvananthapuram

Kerala, CESS scientists appear to have the right combination of expertise in earth sciences, management of land/water resources and natural and man-made hazard studies. However, CESS has had to grapple with shortage of funds and is overstaffed, with the non-plan/plan funds being insufficient even to pay salaries of regular staff. Almost the entire research and development is done using external funds, although three-fourths of the programmes taken up were for the benefit of the state.

Earth system studies at CESS comprise both earth system dynamics (geo-, hydro- and atmospheric dynamics), study of land–water–atmosphere interactions and natural hazards such as earthquakes, landslides, coastal erosion, etc. CESS is among six organizations authorized by the Ministry of Environment and Forests for demarcating the high tide line (HTL). The institute has prepared coastal zone management plan maps and land use maps for coastal panchayats, in the scale of 1 : 25,000 using satellite data or aerial photographs. Studies were conducted on coastal erosion and sediment movement in selected islands of Lakshadweep. Environmental Impact Assessment (EIA) for various schemes such as for mining, hydroelectricity, housing, tourism, etc. was performed by preparation of a coastal erosion zonation map for Kerala. There is an ongoing initiative for studying the crustal blocks found in southern India. Palaeomagnetism and geochemistry studies are under way, of the mafic dykes in the proteozoic Cuddapah basin composed of magmatic rocks. The petrological study of granulites such as charnockite in Kodaikanal–Cardamom Hills, Sabarimala and the Palghat region has been carried out. Kerala's rich deposits of ilmenite and rutile at Chavara have been investigated for their interesting magnetism and chemical properties.

Earth sciences contribute towards understanding of natural hazards and identifying potential areas. The group researching earthquakes is studying the Rann of Kutch for its seismotectonics and correlating this to the history of earthquakes in that region. Palaeoseismicity studies in peninsular India are also being carried out. Terrain evaluation for landslide mitigation studies has been conducted in Kollam District using Geographic Information Systems and understanding the increased incidence of lightning strikes in this district. The identification of radiogenic sources known for high natural background radiation is of interest to scientists in western Kanyakumari District and the Kerala coast. With the support of the Department of Ocean Development, the Coastal Ocean Monitoring and Prediction Systems (COMAPS) for monitoring marine pollution is under way. Levels of dissolved oxygen, suspended particulate matter, nitrogen concentration, zooplankton biomass density, etc. are being recorded along the Kerala coast.

Monitoring effluents dumped by industries off the Kerala coast, their environmental impact, mercury pollution in the river waters of Nilambur, determination of water quality in the school wells of Pazhayakunnummel panchayat, Thiruvananthapuram District are some activities undertaken by CESS. Water would be the next world crisis. Towards water budgeting, CESS has taken up the conservation of Vellayani Lake as a drinking water source for Thiruvananthapuram District. Rainfall intensity measurements are important to the highland areas of Kerala. Hence a watershed atlas of Kannur District was made. Soil erosion and terrain analysis have been taken up in Peppara, and the Idukki Wildlife Sanctuary and the Shola forests in Idukki and Wynad districts respectively. As an input for district plan preparations, a digitized road map for Thiruvananthapuram District and assessment of road transport facilities in Idukki, Kottayam and Alappuzha districts were made, and carrying capacity studies of the Greater Kochi region were conducted.

Biodiversity research is important to Kerala. CESS scientists carried out various soil, geological, hydrological, climatological and geomorphological surveys necessary for data collection. The biodiversity threat in Kerala arises from encroachment, pollution of wetland and siltation. CESS has made an integrated study of the Vamampuram River basin, Neyyar catchment area, Sacred Groves of Kerala and the fast-disappearing mangroves in the Vembanad Estuary. These studies have been aided using GIS and remote sensing data.

Rajiv Gandhi Centre for Biotechnology

It is just over a decade since the Rajiv Gandhi Centre for Biotechnology (RGCB) was created under STEC, catering to the development of the state through biotechnology. The massive 110,000 sq. ft main building complex is about to be completed for a total staff strength of about 100, including 16 scientists. The Department of Biotechnology has already pumped in a research project grant of nearly rupees 18 crore for 1999–2001. RGCB does have the latest equipment for performing biotechnological research, but a walk through some laboratories indicated a paucity of simple but essential pH meters, water-baths and stirrers. The philosophy behind RGCB is 'having research groups around individuals'. There are seven major divisions: infectious diseases, plant molecular biology, environmental biotechnology, molecular human genetics, neurobiology, cancer biology and molecular endocrinology.

Infectious diseases: Studies on the biochemical nature of the Hepatitis C virus (HCV) infection, immune response and host–pathogen interactions have led RGCB to develop a diagnostic kit based on ELISA for detecting Indian strains of HCV. This kit is undergoing multicentric evaluation. The laboratory extends its services to the public referred by local hospitals, for confirmatory diagnosis of HBV and HCV infection using PCR methods. The *Mycobacterium tuberculosis* group is looking at the molecular aspects of the causative organism of TB. They are building up a repository of *M. tuberculosis* in the state by isolating TB bacilli from patients. The group uses Alamar Blue dye reduction assay for screening the strains and fingerprinting the isolates. Drug resistance profile and new drug candidates against *M. tuberculosis* are the other interests of the group. The research activity on *Vibrio cholerae* includes molecular ecology, epidemiology and pathogenesis of *V. cholerae* strains. *V. cholerae* strains from Kottayam, Alleppey and Thiruvananthapuram, numbering about 25, were tested for differential drug susceptibility. These were found to be multi-drug resistant, with differences in antibiotic susceptibility varying with the geographical location in Kerala. Hereditary deafness, the genetics and causative features are the interests of the animal biotechnology group. They have screened 57 families in Kerala for mutations.

Plant molecular biology: The ethnopharmocology group is trying to isolate the active hepatoprotective principles from 'Phyllanthus' and other medicinal pteridophytes of the Western Ghats region in Kerala. A rice variety, *Oryza malampuzhaensis* endemic to the same region is little understood in terms of genetic diversity, population structure, etc. The laboratory has found through their studies that this species is under threat of becoming extinct. Experiments are under way to make black pepper (*Piper nigrum*) vine resistant to diseases by genetic transformation.

Environmental biotechnology: Safe drinking water is a prerequisite for good health. The use of modern PCR-based water quality monitoring in Thiruvananthapuram city area revealed in a few samples, the presence of wild type polio and rota virus contamination. Untreated hospital waste disposed into the domestic sewage system and sewage samples indicated a higher incidence of blood-borne viruses (HCV, HBV and HIV) than that of water-borne viruses (entero, rota, etc.). The group has developed the multiplex RT–PCR-based RFLP analysis for monitoring water quality. Another area of research is the hunt for bacteria as non-toxic natural antifoulants. Marine foulers cause damage to shipping, offshore structures, etc. Bacterial strains from marine algae, off the Mandapam and the Shangumugam coast, have been isolated for their potential as antifoulants.

Molecular biology of genetic diseases: Kerala's tribal population and other ethnic communities are being studied for their genetic diversity and predisposition to diseases. Methods such as DNA fingerprinting, immunogenetic and pharmacogenetic profiling are used in diseases like schizophrenia, spondyloarthritis and cancer.

Molecular basis of biological functions: The study of the molecular basis of biological function includes the molecular endocrinology group, which researches the biology of estrogen receptors in mammalian uterus, the cancer biology group and the neurobiology group. The cancer biology group concentrates on the cancer of the uterine cervix, the most prevalent form of cancer among Indian women. Curcumin, the yellow pigment of turmeric (*Curcuma longa*) is a potent anti-inflammatory agent and an antioxidant. Certain cell types are resistant to apoptopsis by curcumin; so understanding the reason for this is of interest to cancer biologists in the hope of developing curcumin-based anti-cancer therapies. Another study by the same group focuses on the effects of garlic on the proliferation and apoptosis of cancer cells. The neurobiology group is studying the interaction among proteins present at neuronal synapses, thought to be involved in memory and learning.

Sree Chitra Tirunal Institute for Medical Sciences and Technology

This institute (SCTIMST) was formally inaugurated in 1976 and is one of national importance (1980), with the status of a university. What makes it so unique is that one can see the best of medical science and technology under one roof, complementing each other. In 1973, the erstwhile royal family of Travancore gifted land and the beautiful Satelmond Palace that now houses the Biomedical Engineering and Technology wing of the institute. Goals set for SCTIMST are to develop appropriate technologies to meet the health care needs of the country, initiate training and research programmes integrating biomedical technology and health sciences, and maintaining high standards of patient care in medical specialities. The institute is supported by the Department of Science and Technology.

Medical technology and biomedical research: The medical devices market is of approximately Rs 5000 crore; yet most of the country's needs are met through imports. Sadly, the medical devices industry is still in its fledgling stage, and there is surprisingly no medical device policy or legislation, even in 2002. There is urgent need for legislation or else we might be using sub-standard medical devices in life-threatening situations! Just as there is a Drug Controller, there has to be a Medical Devices Controller. SCTIMST has contributed successfully its mite to this industry with the Laboratory for Dental Products, Modelling and Prototyping and Devices Testing Laboratories (focusing on development and standardization of test methodologies for evaluation of medical devices conforming to national and international standards) and an instrumentation laboratory for development work in medical instrumentation.

The well-known successes of SCTIMST include the 'Chitra heart valve', blood bags, blood oxygenator and hydrocephalus shunt. There are presently about 5000 people walking around with the Chitra heart valve and 80 centres using the valve. About 2000 patients would be fitted with this device in 2002; and this is expected to rise to about 5000 per year, by 2005. Improvements are under way for optimizing the fluid-flow design to increase blood throughput and uniformity of flow and reduce thrombogenicity. For this, new materials and coating types are being evaluated at the laboratory stage. Among technologies recently developed are:

- *Dental composites*: Technology transfer has been effected in four dental products: chemical cure, light cure, radiopaque dental composite and dentine bonding agent. These are now undergoing multi-centric evaluation in selected dental hospitals.

- Technology for fibrin glue and haemostatic fibrin sheet developed by the Thrombosis unit is also transferred and their evaluation begun.
- The Bioceramics laboratory has transferred to industry bioactive glass composite and porous hydroxy apatite granules for ceramic surgical implant and bone regenerations which are biocompatible and serve as an osteoconductive bone repair material.
- A hollow fibre membrane oxygenator is in the final series of animal experiments. It consists of a polycarbonate reservoir, connectors, polypropylene hollow fibres, anodized heat exchangers with a rotating venous inlet and an oxygenation module.
- Chitosan-based wound dressings developed by the Bio-surface Technology Division can be used in dressing chronic ulcers and is presently under clinical evaluation.
- Other developments include devices and materials suitable for application in vascular graft, haemodialysis membranes, artificial skin and biomaterial such as hydrogel microspheres for applications in embolotherapy.

Clinical research: In addition to the clinical research described below, several other departments also conduct clinical research, such as the Division of Biochemistry, Neurosurgery, Pathology and Radiology.

Division of Cellular and Molecular Cardiology: Cardiac care and growth of cardiology in Kerala can be traced back to its origins at the Medical College, Thiruvananthapuram. A multidimensional approach to the field of cardiology is evident at SCTIMST which has four major areas, namely clinical and educational cardiology, biomedical practices, basic cardiac research and cardiac epidemiology.

The molecular basis of endomyocardial fibrosis (EMF) and the origin of the pathogenesis of the disease investigated by the group at SCTIMST have led to the culprit, cerium which forms the basis of the geochemical hypothesis of tropical EMF. Cerium (constituting 30% by weight) occurs in the monazite sands off the Kerala coast, which in combination with magnesium deficiency could be the cause of EMF. It is a disease that is specific, has a geographical distribution around the equator, with the poor who easily succumb to malnutrition and diahorreal diseases falling prey to EMF. Other research areas are molecular mechanisms in cardiac fibrosis, free radical stress in cardiac ailments and the effect of vitamin D and its relationship to coronary artery disease (CAD) in the tropics. The Achutha Menon Centre for Health Sciences under SCTIMST has, along with other organizations, undertaken a cardiac epidemiological study of Kerala.

Department of Neurology: Clinical research is ongoing in the area of epilepsy. A study of the prevalence, knowledge, attitude and practice of epilepsy in Kerala revealed that the pattern does not differ from that of developed countries. Although awareness was comparable, the attitudes of the people were negative. A significant factor in reducing the effect of this disorder in the daily activities of the patient is to provide the family with enough information to dispel misconceptions associated with the disease. An epilepsy counselling and training module is available at the R. Madhavan Nayar Centre for Comprehensive Epilepsy Care, Department of Neurology. The centre also coordinates the activities of the registry of epilepsy and pregnancy on a national level. Since 1995, the centre has performed about four hundred medically refractory epilepsy surgeries. An *Epilepsy News* is brought out by the centre to disseminate current status of epilepsy research.

The Health Sciences wing of SCTIMST is the Achutha Menon Centre (AMC). Its main objective is to train health professionals in health research and the formulation and implementation of health policies. It conducts an international Master of Public Health (MPH) programme, short courses and Ph D programme for all South Asian countries. The centre is also the secretariat for the Public Health Schools without Walls Networking Initiative in Asia and Africa. The research programme covers epidemiology with projects such as detection and monitoring of hypertension in Kumarakom, Kerala, diarrhoea morbidity in under-five children in selected villages of Kerala and Tamil Nadu, and surveillance of cardiovascular diseases (CVD) risk factors. Other projects are gender and social issues in reproductive health research and health sector reform.

A high standard of patient care at the hospital (corroborated through locals) with medical records that can be easily retrieved on demand puts SCTIMST on track to successfully meet global challenges.

Regional Research Laboratory

The Regional Research Laboratory (RRL) is part of the Team CSIR laboratories nestled in Pappanamcode, Thiruvananthapuram. Research activities at RRL are divided into nine areas, namely agro-processing, photochemistry, speciality polymers, mineral processing, structural and electronic ceramics, alloys and composites, waste water technology, and organic synthesis.

Agro-processing: In India, this particular area of technology development is of significance. For example, this Unit has established palm oil mills in Goa, Gujarat, Orissa and Tamil Nadu. A process has been developed to retain in red palmolein more than 60% of the original carotene and about 80% of the tocopherols. Oleoresins and flavours from fresh spices have been developed from turmeric, ginger and pepper. A fresh-ginger processing plant has been commissioned at Manipur for obtaining ginger oil.

Photochemistry: At the Photochemistry Research Unit the areas of active interest are molecular/nanomaterials, macromolecular/supramolecular materials, photobiology and photoinduced electron transfer. This is one of the three laboratories identified to coordinate the CSIR programme on Photonics under the Tenth Five Year Plan. Research at this Unit has potential for applications such as photovoltaic devices, organic light-emitting diodes, photoswitchable liquid crystals, low-band conducting polymers and photodynamic therapy for cancer. In photoinduced electron transfer, the main focus is to understand important photoprocesses. Other interesting research projects are the design and study of photophysical properties of squaraine and ruthenium-based dyes coated on large band gap semiconductors, storage of light in the form of chemical energy using fullerene-based dyads that are tuned with different donors and acceptor pairs, and light-harvesting devices in the form of nanoparticles of transition metals. The Unit also has research interests in the development of organic material for electrooptic applications, with the design of inherently active liquid crystalline materials and development of sensitizers for biological applications.

Speciality polymers: A successful development of a commercial process for manufacture of panelling material and veneers of banana fibre composites, uses a device that cleaves the leaf-sheath without splitting in banana plantations. Other projects are melt processable liquid crystalline polymers and thermochemical processing for value addition of China clay. Systematic studies have been undertaken on the structure, physical and mechanical properties of plant fibres of Kerala such as coconut, banana, sisal, pineapple, palmyrah and talipot for development of plant fibre-reinforced polymer composites and preparation of useful products made from cashew nut shell liquid, a by-product of the cashew industry.

Mineral processing: China clay and heavy mineral sand like ilmenite are abundantly found in Kerala. In collaboration with industries beneficiation technologies have been developed that give value addition to the minerals. In the case of China clay, this has helped upgrade sub-premium quality clay raw material to paper-coating-grade products. Similarly, an environment-friendly process for the manufacture of high-grade synthetic rutile has been developed. From waste and industrial by-products like glass, flyash with aluminium, clay or polymer are used as matrices for wear resistance and building material applications.

Structural and electronic ceramics: The range of research varies from high density ceramics for use at low temperatures, to helping the Kerala tile industry scientifically modernize, with evaluation of raw materials and use of optimum blends. Ten-metre long multifilamentary superconducting tapes in helical coil form have also been fabricated. The electronic ceramics group concentrates mainly on work associated with high T_c superconductors. Other ongoing projects are in the area of sol-gel self-cleaning coatings, ultra and nano filtration catalytic ceramic membranes, monazite ceramics, dielectric resonators and microwave resonators for communication.

Alloy and composites group: An Al–Si alloy sand casting has been developed, which can be used at different temperatures and components fabricated for use in space applications and aluminium metal matrix composites for nuclear and automotive applications.

Organic and natural product synthesis: There is a programme to isolate, modify and evaluate biologically active compounds from plant sources under a CSIR inter-laboratory programme. Some of the plants currently under scrutiny are from the Zingiberaceae, Lamiaceae and Mimosidaceae families that grow abundantly in Kerala. The organic synthesis group is interested in carbon–carbon and carbon–heteroatom chemistry through novel methods using ecofriendly reagents and catalysts. The resultant synthetic products have potential use in drugs and pest control. The method frequently employed with success is a multicomponent reaction in which at least three chemical functionalities join through covalent bonds, giving enhanced speed, efficiency and are environment-friendly.

Waste water technology programme: This provides service to industry in environmental technology. Among the projects undertaken are: a hydrogen sulphide inhibition control system for the effluent treatment of a pencillin G plant, anaerobic filter in a milk-chilling plant, biofilter for deodourization of off-gas from chemical factories, anaerobic digester for biosolids containing waste water and a process to selectively remove iron and silica from process water for reuse in clay refining. The above projects were done for industries both in Kerala and those of neighbouring states. These technologies can be of benefit to greening existing industries that deal with a variety of products, ranging from sewage-treatment plants, chemicals and petrochemicals, agro-based industries to ice-cream factories.

Centre for Marine Analytical Reference and Standards: This centre is trying to achieve quality in measurement of the marine environment in the Coastal Ocean Monitoring and Predictive Systems Programme of the Department of Ocean Development, involving ten national laboratories and a state unit.

The RRL, Thiruvananthapuram is currently in the process of augmenting its strengths by a process of internal reorganization with an accent on more focused projects under a new Director, Javed Iqbal, an organic chemist with experience in both academia and industry.

Nirupa Sen, 1333 Poorvanchal Complex, JNU New Campus, New Delhi 110 067, India (e-mail: nirupasen@vsnl.net).